NOAA Technical Memorandum
NMFS-SEFC-46

# CATCH COMPOSITION, SEASONALITY, AND DISTRIBUTION OF ICTHYOPLANKTON FROM R/V ONSLOW BAY MONTHLY CRUISES IN ONSLOW BAY AND NEWPORT RIVER ESTUARY, NORTH CAROLINA , 1972-1974.

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October 1982

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Beaufort Laboratory
Beaufort, North Carolina 28516

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William G. Gordon, Assistant Administrator
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## ABSTRACT

Plankton samples were collected monthly in North Carolina coastal waters from October 1972 to April 1974. Stations were located in offshore and inshore ocean zones in Onslow Bay and in the Newport River estuary. A wide variety of fish larvae were represented. Identified larvae included 50 families, 19 genera, and 12 species. Of the three areas sampled the offshore ocean area, with greatest water depth, was the most productive in both larval abundance and diversity. Of 65 identified taxa, 62 were found offshore, 51 inshore, and 34 in the estuary.

## INTRODUCTION

As the human population increases in coastal areas, there is a growing concern over the impact of man's activities on plants and animals in estuarine and coastal zones. It is difficult to assess this impact without adequate information on plants and animals occurring naturally in these areas. Of particular concern are data relating to eggs and larvae of fishes that spawn along the continental shelf and in the estuaries. Ichthyoplankton abundance, particularly in estuaries, can be altered by domestic or industrial pollution. Investigators monitoring the effects of this pollution need information on the occurrence, relative abundance, and seasonal distribution of fish larvae in these waters.

In recent years there have been several cruises designed specifically to collect eggs and larvae of fish that spawn in waters along the Atlantic coast of the United States. The data discussed in this paper are from a study confined to the central section of North Carolina coastal waters. Stations were

systematically sampled in offshore and inshore ocean zones in Onslow Bay and in the Newport River estuary from October 1972 to April 1974, primarily to collect larvae of Atlantic menhaden, Brevoortia tyrannus.

A wide variety of other larvae were also collected. In addition to menhaden, two other important commercial species, spot, Leiostomus xanthurus, and Atlantic croaker, Micropogonias undulatus, were also abundant. Distribution and abundance have been reported for menhaden larvae by Nelson, Armstrong, and Judy[1/] and for spot and croaker larvae by Lewis and Judy[2/]. In this report I have summarized the data, mainly in tabular form, for all identified larvae, and have included a brief discussion of seasonal and areal variations in larval distribution and of methodology.

## METHODS

Monthly collections were made with paired 60-cm bongo plankton nets (0.333 and 0.505 mm mesh), weighted with a 100 lb lead weight, from the 48-ft R/V Onslow Bay. At each station two to four oblique tows, depending on water depth, were made from the surface to near the bottom for a minimum of 5 minutes at a speed of 1 1/2 kt. Depth was recorded with a bathykymograph attached just above the nets. Flow rates were estimated by torpedo-shaped digital current meters (made by General Oceanico, Inc., Miami, Fla.[3/]) placed in the center of the mouth of each net.

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[1/] Nelson, W. R., R. Armstrong, and M. H. Judy. Distribution of larval Atlantic menhaden, Brevoortia tyrannus, as related to possible transport mechanisms. Unpublished manuscript.

[2/] Lewis, R. M., and M. H. Judy. The occurrence of spot, Leiostomus xauthurus, and Atlantic croaker, Micropogonias undulatus, larvae in Onslow Bay and Newport River estuary, North Carolina. Unpublished manuscript.

[3/] Reference to trade names is for identification purposes and does not imply endorsement by the National Marine Fisheries Service, NOAA.

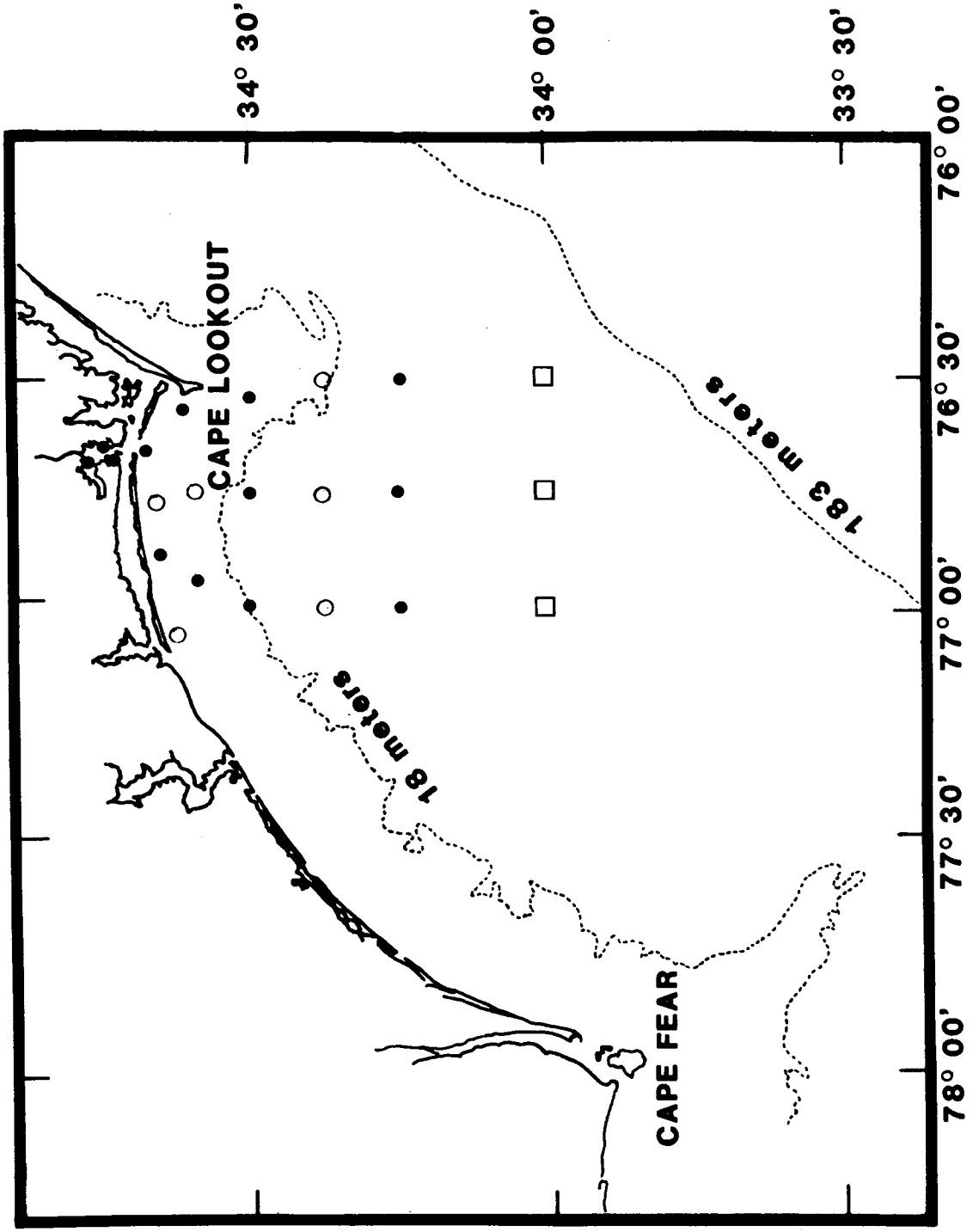


Figure 1. Location of stations sampled monthly for ichthyoplankton from October 1972-April 1974 (Dots), October 1972-September 1973 (Circles), and October 1973-April 1974 (Squares).

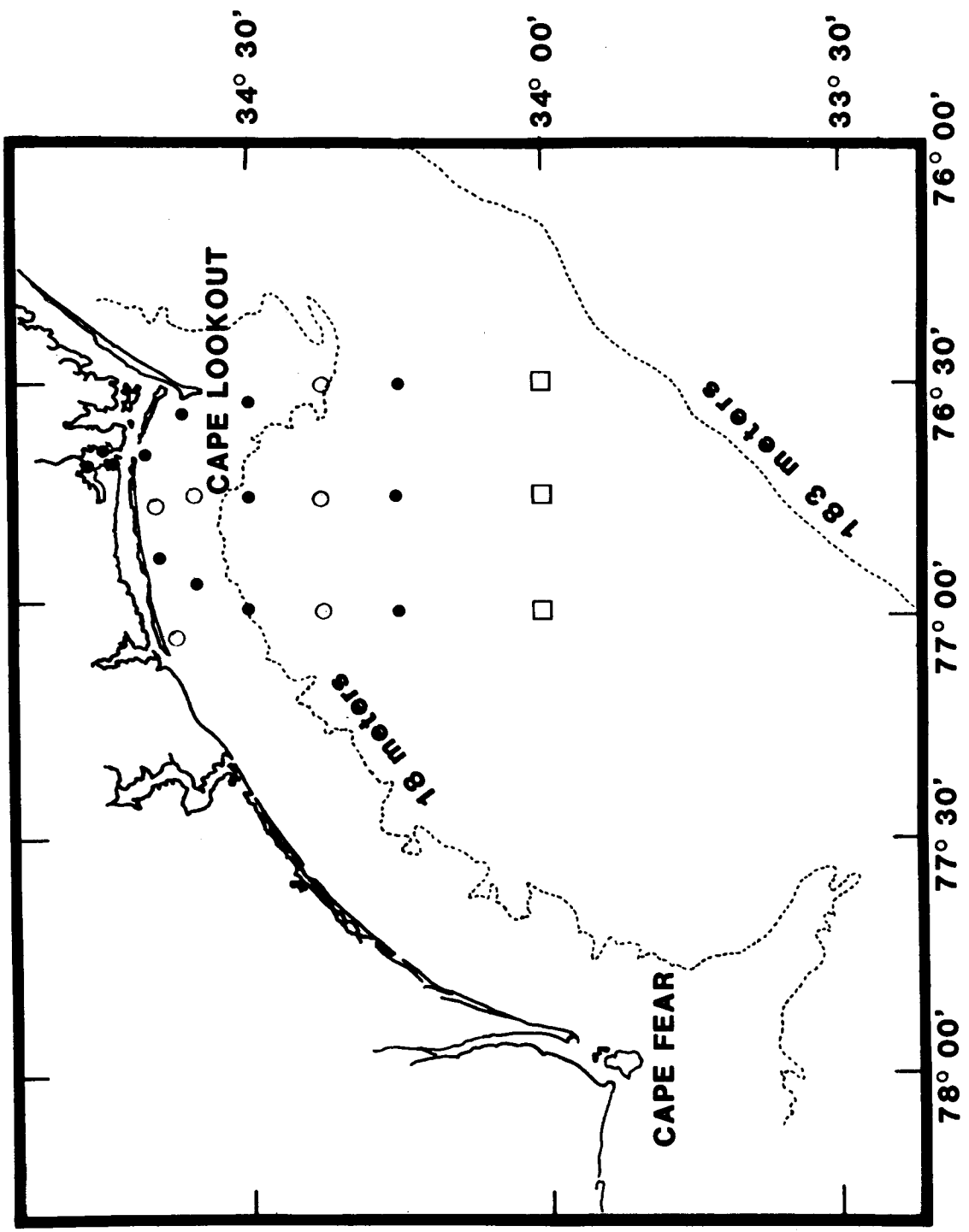


Figure 1. Location of stations sampled monthly for ichthyoplankton from October 1972-April 1974 (Dots), October 1972-September 1973 (Circles), and October 1973-April 1974 (Squares).

Three areas were sampled: offshore, inshore, and estuarine (Fig. 1). Depth of offshore stations, ranging from 32 to 79 km from shore, varied from 21.9 to 40.2 m. Depth of inshore stations, ranging from 3 to 22 km from shore, varied from 14.6 to 20.1 m. Dept of estuarine stations varied from 1.8 to 12.8 m. From October 1972 to September 1973, 19 stations were sampled, 6 offshore, 9 inshore, and 4 estuarine. In October 1973, three inshore stations were deleted and three offshore locations were changed. Because the Onslow Bay had limited range and returned to port each night, about 5 days per month were required to run all stations. During the 19-month period, sampling was missed completely one month and only partially completed six others, due either to bad weather or to equipment failure.

## RESULTS

Total volume of water filtered by each bongo net was: 20,308 $m^3$ for the 0.333 mm mesh and 21,056 $m^3$ for the 0.505 mm mesh. Volumes filtered per tow ranged from 46.3 $m^3$ to 132 $m^3$ for the 0.333 net and from 48.8 $m^3$ to 139 $m^3$ for the 0.505 net.

Extrusion of larvae smaller than 4 mm was less through the 0.333 mm mesh net, but catches of larvae larger than 10 mm were higher in the 0.505 mm mesh net, probably because flow rates also were higher.

The actual number of larvae caught per station ranged from 0 (2 stations) to 5,501. Average monthly catch per station ranged from 33 in March 1974 to 1,234 in June 1973. Total catch was 74,316.

Catches from the estuarine area were the most variable, catches from the offshore area the least variable. Catches in the estuary ranged from an average of 2 larvae per station in November 1972 to 2,792 in June 1973. Offshore catches ranged from an average of 30 larvae per station in

March 1973 to 805 in August. Average larval catch per station for the entire sampling period was 291 offshore, 208 inshore, and 286 estuary. These figures, especially those for the estuary, are somewhat misleading due to a large catch of Anchoa larvae in June 1973. If Anchoa larvae for June are deleted, the average-catch per station changes to 286 offshore, 193 inshore, and 153 estuary, a decline of 1.7%, 9.2%, and 46.5%, respectively.

Larval catches also varied by season. Catch per station was 776 during the spring of 1973 (May and June only; samples were not taken in April), 468 in summer, but less than 100 during fall and winter. Seasonal trends were similar to those recorded during three cruises by the R/V Dolphin in the South Atlantic Bight in 1973 (Powles and Stender 1976).

Samples were preserved in a 5% solution of buffered Formalin[3/]. Larvae and eggs were removed from samples with the aid of a dissecting microscope. After larvae were identified the number and length-range in each taxon were recorded.

Counts were adjusted to a standard catch at each station using the following formula:

$$SHF = 100 \div V/D$$

where: SHF = standard haul factor

V = volume of water strained ($m^3$)

D = depth of sample (m)

100 = number of square meters of surface area.

For example, a tow which strained 60 $m^3$ of water through a depth of 12 m provided a standard haul factor of 20. Multiplying the number of larvae in the catch by the SHF gives an estimate of the number of larvae in the entire water column under a surface area of 100 $m^2$. Thus, the calculated number represents an estimate of the total population and is dependent on both density (no. per $m^3$) and depth.

The number of taxa varied by station, area, month, and season. A total of 65 were recorded. Number per station ranged from 0 to 24. The station with the lowest number, in the inshore area, averaged 3.3 per month, and the station with the highest number, in the offshore area, averaged 14.5. For the three areas, the average number per month for all stations was 4.4 for the estuary, 8.0 inshore, and 13.3 offshore. Number per month ranged from 11 in January 1973 to 39 in September. Number by season varied from 22 in fall and winter of 1972-73 to 46 in summer.

Twelve orders, comprising 50 families (Pleuronectiform larvae were assumed to comprise 4 families), 19 genera, and 12 species were identified. Unidentified larvae (9,045) accounted for approximately 12% of the total catch.

Five orders accounted for approximately 98% of the identified larvae: Clupeiformes (33,361 specimens; 3 families), Perciformes (21,305 specimens; 22 families), Pleuronectiformes (4,528 specimens; 4 families), Gadiformes (2,563 specimens; 4 families), and Tetraodontiformes (2,370 specimens; 3 families). Each of the remaining orders and number of specimens were: Myctophiformes (417 specimens; 2 families), Atheriniformes (291 specimens; 2 families), Anguilliformes (219 specimens; 5 families), Gasterosteiformes (169 specimens; 1 family), Lophiiformes (43 specimens; 2 families), Elopiformes (4 specimens; 1 family), Beryciformes (1 specimen).

Abundance by family varied from one larva per family for the Congridae, Apogonidae, Holocentridae, Ammodytidae, and Ostraciidae to 30,930 for the Engraulidae (Table 1). Engraulidae accounted for approximately 47% of identified larvae, Sciaenidae 11%, and each of the other families less than 5%.

Table 1. Numbers of larvae, by order, family, and species, seasons present, time of peak abundance, and area of occurrence, in samples taken monthly in North Carolina coastal waters from October 1972 to April 1974 with a pair of 60 cm bongo nets having 0.333 and 0.505 mm mesh.

| Order | Family | Genus/Species | Number | Seasons[1/] Present | Peak Abundance | Area[2/] |
|---|---|---|---|---|---|---|
| Elopiformes | Elopidae | Unidentified | 4 | W S | Jan | E O I |
| Anguilliformes | Anguillidae | Unidentified | 9 | Sp S A | Apr, Nov | O |
| | Muraenidae | Unidentified | 4 | W A | Oct | E O |
| | Congridae | Unidentified | 1 | S | Jul | O |
| | Ophichthidae | Unidentified | 188 | W Sp S A | Sep, Jan | O I E |
| | Nettastomidae | Unidentified | 17 | W | Jan | O I |
| Clupeiformes | Clupeidae | Unidentified | 17 | W Sp S | | O I |
| | | Sardinella sp. | 1,434 | Sp S A | Aug- Sep | O I |
| | | Brevoortia tyrannus | 607 | W Sp A | Jan- Feb | E I O |
| | | Opisthonema oglinum | 321 | Sp S | Jun- Jul | I O E |
| | | Etrumeus teres | 47 | W | Jan- Feb | O I |
| | Engraulidae | Unidentified | 10 | Sp | Jun | O |
| | | Anchoa sp. | 30,920 | W Sp S A | May- Sep | E I O |
| | Sternoptychidae | Vinciguerria sp. | 5 | Sp S A | Apr | O |
| Myctophiformes | Synodontidae | Unidentified | 349 | W Sp S A | Apr- Jun | O I E |
| | Myctophidae | Unidentified | 68 | W Sp S A | Apr, Jan | O I |
| Lophiiformes | Lophiidae | Unidentified | 22 | W Sp S | Mar- Apr | O I |
| | Antennariidae | Unidentified | 21 | Sp S | Apr, Sep | O |
| Gadiformes | Bregmacerotidae | Unidentified | 23 | W Sp S A | Jan | O I |
| | Gadidae | Urophycis sp. | 441 | W S A | Jan | O I E |
| | Ophidiidae | Unidentified | 2,090 | W Sp S A | Jun, Apr, Sep | O I E |
| | Carapidae | Unidentified | 9 | S | Sep | O I |
| Atheriniformes | Exocoetidae | Unidentified | 18 | S | Sep | O I |
| | Atherinidae | Unidentified | 273 | W Sp S A | Apr | E O I |
| Beryciformes | Holocentridae | Unidentified | 1 | A | Dec | I |
| Gasterosteiformes | Syngnathidae | Unidentified | 169 | W Sp S A | Mar- Sep | E O I |
| Perciformes | Serranidae | Unidentified | 424 | W Sp S A | Jun- Sep | O I E |
| | | Centropristis striata | 79 | W Sp S A | Jan- Apr | O I |
| | Apogonidae | Unidentified | 1 | W | Jan | O |
| | Pomatomidae | Pomatomus saltatrix | 3 | Sp | May | O I |
| | Carangidae | Unidentified | 1,527 | W Sp S A | Jun, Sep | O I E |
| | Lutjanidae | Unidentified | 3 | Sp S | May- Jun | O I |
| | Pomadasyidae | Orthopristes chrysoptera | 15 | W S | Feb | O I |
| | Sparidae | Unidentified | 1,024 | W Sp S A | Feb- Apr, Jun | O I E |
| | | Lagodon rhomboides | 760 | W Sp A | Jan- Feb | E O I |
| | Sciaenidae | Unidentified | 2,332 | W Sp S A | Jun, Oct | E I O |
| | | Leiostomus xanthurus | 3,577 | W Sp A | Dec- Feb | E O I |
| | | Micropogon undulatus | 1,348 | W Sp A | Nov- Feb | E O I |
| | | Stellifer lanceolatus | 100 | Sp S A | Aug | I O E |
| | | Cynoscion sp | 62 | W S A | Jul | E I O |
| | Labridae | Unidentified | 400 | W Sp S A | Jun- Aug | O I E |
| | Mugilidae | Unidentified | 11 | W Sp S | May, Jul | O E |
| | Sphyraenidae | Unidentified | 2 | W Sp | Apr | O I |
| | Uranoscopidae | Unidentified | 34 | W Sp S A | Apr- May | O I E |
| | Blennidae | Unidentified | 1,814 | W Sp S A | May- Sep | E I O |
| | Ammodytidae | Unidentified | 1 | Sp | May | O |
| | Gobiidae | Unidentified | 1,782 | W Sp S A | Jun | O E I |
| | Gempylidae | Unidentified | 3 | W A | Jan | O |
| | Trichiuridae | Unidentified | 627 | Sp S | Sep | O I |
| | | Trichiurus lepturus | 2,008 | W Sp S A | Jun- Oct | O I E |
| | Scombridae | Unidentified | 241 | Sp S | Jun- Aug | I O |
| | Stromateidae | Unidentified | 2 | W Sp | Jan, Jul | O I |
| | | Peprilus triacanthus | 72 | W Sp S A | Apr- Jun | O I E |
| | Scorpaenidae | Unidentified | 35 | W Sp S A | Apr | O I |
| | Triglidae | Unidentified | 2 | Sp | Jun | O |
| | | Prionotus sp | 2,984 | W Sp S A | Apr- Jun Oct-Nov | O I E |
| | Cottidae | Unidentified | 32 | W Sp S | Jun- Jul | O I |
| Pleuronectiformes | Bothidae | Unidentified | | | | |
| | Pleuronectidae | Unidentified | | | | |
| | Cynoglossidae | Unidentified | 4,528 | W Sp S A | Dec- Jan, Apr,Aug | O I E |
| | Soleidae | Unidentified | | | | |
| Tetraodontiformes | Balistidae | Unidentified | 729 | W Sp S A | Apr, Jun | O I E |
| | | Monacanthus sp | 12 | W Sp A | May | O I |
| | Ostraciidae | Unidentified | 1 | Sp | Jun | O |
| | Tetraodontidae | Unidentified | 1,628 | W Sp S A | Aug- Sep, Apr,Jun | O I E |
| | | | 65,271 | | | |

1/ W = Winter Sp = Spring S = Summer A = Autumn
2/ O = Offshore, I = Inshore, E = Estuary Areas listed according to larvae abundance

Three families, plus the Pleuronectiformes, were present each sample month, 18 were present 12 or more months, and 15 were present each month of the calendar year. Nineteen families were present 4 months or less.

Family occurrences by station ranged from 74% for Sciaenidae to less than 1% for five families. Triglidae was the only family other than Sciaenidae that occurred at more than 50% of the stations. Eight families were found only at offshore stations and 23 were found either offshore or inshore but not in the estuary. The number of families represented in each of the 3 areas was 49 offshore, 41 inshore, and 28 estuarine.

Generic or specific identifications were made for 13 families. Classification to genera (35,858 specimens) accounted for 80% of larvae identified below family and classification to species (8,937 specimens), 20%. Menhaden, spot, and croaker accounted for 62% of the larvae at the species level.

Larval abundance in the entire water column under a surface area of 100 $m^2$, extending from the surface to the sea floor, was estimated by adjusting the actual number caught at each station by the standard haul factor (refer to methods sect.) Estimated monthly abundance for all stations combined varied from 10,055 (March 1973) to 533,563 (June 1973), and averaged 95,179 (Table 2). More than 100,000 larvae were estimated to have been present each month from May to September 1973. Offshore, where water depth was greatest, estimated monthly abundance varied from 4,863 (March 1973) to 144,180 (June 1973), and averaged 46,828. Inshore, where water depth was intermediate, estimated monthly abundance varied from 697 (February 1974) to 148,793 (June 1973), and averaged 32,445. In the estuary, where water depth was relatively shallow, estimated monthly abundance varied from 149 (November 1972) to 240,590 (June 1973), and averaged 18,507.

Table 2. Estimated larval abundance by month and area for all stations combined and average estimated abundance for each station October 1972 - April 1974.

| Year Month | Offshore No. of larvae | Offshore No. of sta. | Offshore No. per sta. | Inshore No. of larvae | Inshore No. of sta. | Inshore No. per sta. | Estuary No. of larvae | Estuary No. of sta. | Estuary No. per sta. | All areas No. of larvae | All areas No. of sta. | All areas No. per sta. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | | | | | | | | | | | | |
| OCT | 18,914 | 4 | 4,728 | 11,284 | 7 | 1,612 | 1,171 | 4 | 293 | 31,369 | 15 | 2,091 |
| NOV | 19,596 | 6 | 3,266 | 8,658 | 9 | 962 | 149 | 4 | 37 | 28,403 | 19 | 1,495 |
| DEC | 26,963 | 6 | 4,494 | 7,720 | 9 | 858 | 358 | 4 | 90 | 35,041 | 19 | 1,844 |
| 1973 | | | | | | | | | | | | |
| JAN | 11,756 | 6 | 1,959 | 3,662 | 9 | 407 | 7,729 | 4 | 1,932 | 23,147 | 19 | 1,218 |
| FEB | 14,240 | 6 | 2,373 | 3,345 | 9 | 372 | 28,140 | 4 | 7,035 | 45,725 | 19 | 2,407 |
| MAR | 4,863 | 6 | 810 | 2,804 | 9 | 312 | 2,388 | 4 | 597 | 10,055 | 19 | 529 |
| MAY | 43,306 | 6 | 7,218 | 35,150 | 9 | 3,906 | 22,241 | 4 | 5,560 | 100,697 | 19 | 5,300 |
| JUN | 144,180 | 6 | 24,030 | 148,793 | 9 | 16,533 | 240,590 | 4 | 60,148 | 533,563 | 19 | 28,082 |
| JUL | 52,984 | 6 | 8,831 | 62,104 | 9 | 6,900 | 8,384 | 4 | 2,096 | 123,472 | 19 | 6,499 |
| AUG | 132,269 | 6 | 22,045 | 142,796 | 9 | 15,866 | 9,428 | 4 | 2,357 | 284,493 | 19 | 14,973 |
| SEP | 119,121 | 6 | 19,854 | 75,902 | 9 | 8,435 | 8,666 | 4 | 2,166 | 203,689 | 19 | 10,720 |
| OCT | - - | - | - - | 35,986 | 6 | 5,998 | 522 | 4 | 130 | 36,508 | 10 | 3,651 |
| NOV | 47,721 | 6 | 7,954 | 15,917 | 6 | 2,652 | 212 | 4 | 53 | 63,850 | 16 | 3,991 |
| DEC | 12,724 | 2 | 6,362 | 10,371 | 6 | 1,729 | 299 | 4 | 75 | 23,394 | 12 | 1,950 |
| 1974 | | | | | | | | | | | | |
| JAN | 72,355 | 6 | 12,059 | 9,692 | 6 | 1,615 | 867 | 4 | 217 | 82,914 | 16 | 5,182 |
| FEB | 26,293 | 3 | 8,764 | 697 | 6 | 116 | 533 | 3 | 178 | 27,523 | 12 | 2,294 |
| MAR | 11,177 | 3 | 3,726 | 2,872 | 6 | 479 | 252 | 4 | 63 | 14,301 | 13 | 1,100 |
| APR | 37,610 | 2 | 18,805 | 6,257 | 6 | 1,043 | 1,204 | 4 | 301 | 45,071 | 12 | 3,756 |
| TOTAL | 796,072 | 86 | 9,257 | 584,010 | 139 | 4,202 | 333,133 | 71 | 4,692 | 1,713,215 | 296 | 5,788 |

## SUMMARY

A variety of fish larvae was caught in North Carolina coastal waters from October 1972 to April 1974. Larvae were present each month of the year, and were found at all but two of 296 stations sampled. Twelve orders, comprising 50 families (4 included under Pleuronectiformes but not separated into family groups), 19 genera, and 12 species were represented. The number of taxa varied monthly from 11 (January 1973) to 39 (September 1973) with a total of 65 for the 18 months in which samples were collected.

Of three areas sampled the offshore ocean area, with greatest water depth, was the most productive in both larval abundance and diversity and in number of taxa. Based on the number of stations worked in each area, larval abundance offshore was 55% greater than inshore (intermediate water depth) and 49% greater than in the estuary (relatively shallow water depth). Of 50 families, 49 were found offshore, 41 inshore, and 28 in the estuary. Of 65 identified taxa, 62 were found offshore, 51 inshore, and 34 in the estuary.

Larvae were more abundant during spring and summer than during fall and winter. May to September accounted for approximately 73% of all larvae. June was the most productive month, March the least productive. The number of taxa, by season (months combined for all years) varied from 38 in fall to 49 in spring. Winter and summer accounted for 43 and 46 taxa, respectively.

## Literature Cited

Powles, Howard and Bruce W. Stender. 1976. Observations on composition, seasonality and distribution of ichthyoplankton from MARMAP cruises in the South Atlantic Bight in 1973. S.C. Mar. Resour. Center Tech. Rep. 11: 1-47.